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**ANNUAL EVALUATION OF
CONNECTICUT'S INSPECTION/MAINTENANCE PROGRAM**

2014

FINAL REPORT

Prepared for:

Connecticut Department of Energy and Environmental Protection

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Executive Summary

As required by the Clean Air Act (CAA) Amendments of 1990, the Connecticut Department of Energy and Environmental Protection (DEEP) in partnership with the Connecticut Department of Motor Vehicles (DMV) conducts periodic evaluations of its enhanced Motor Vehicle Inspection and Maintenance (I/M) Program. This report is being submitted in fulfillment of the requirements to provide an annual I/M report per 40 CFR 51.366. This report addresses data collected from January 1, 2014 through December 31, 2014. As evidenced by the high compliance rate, limited fraud and low waiver rate, this report demonstrates that Connecticut's I/M program effectively achieves air quality benefits.

The United States Environmental Protection Agency (EPA) provided a checklist (Appendix A), which identified the data elements to be included in this report. The 2014 data elements are compiled in Appendix B and correspond to the indexing system used in EPA's checklist. Due to the structure of Connecticut's I/M program, the following requirements of the attached checklist are not applicable: (a)(2)(xiii), (xiv), (xv), (xvi), (xvii), (xviii), (xx) and (5); (b)(3)(ii), and (iv); (4)(iii), (6), (7); (d)(3) and (4).

Connecticut's I/M program, which dates back to 1983, has a long history of effectively reducing vehicle emissions and results in more emission reductions than any other state-implemented reduction strategy. The I/M program, designed to identify vehicles that emit pollutants that exceed acceptable standards and require such vehicles to get repaired, is an important part of the strategy to ensure that Connecticut is positioned to attain and maintain the National Ambient Air Quality Standard (NAAQS) for Ozone (i.e., smog). Current estimates indicate that in 2010, this program would have provided approximately 19 of the 200 tons per day of air pollutant reductions that are included in [Connecticut's Attainment Demonstration for the 1997 Ozone NAAQS](#). The emission reductions resulting from this program are an integral part of Connecticut's air quality attainment efforts, and important as part of a balanced strategy that includes reductions from stationary, area and mobile source sectors to ensure that Connecticut attains the 1997 Ozone NAAQS. EPA has since strengthened the Ozone NAAQS in 2008 resulting in Connecticut's designation of nonattainment for this standard as well. Connecticut failed to comply with the 2008 Ozone NAAQS in the timeframe provided by the federal CAA and will be subject to additional requirements upon formal notification by EPA. Furthermore, EPA is expected to issue an even more stringent Ozone NAAQS in 2015. If EPA does so, Connecticut will need to achieve even greater emission reductions from motor vehicles.

Since the inception of the I/M program in 1983, the primary source of Connecticut's 'home grown' air pollution has shifted from large industrial facilities like power plants and factories to motor vehicles and others sources in the transportation sector. In Connecticut, motor vehicles now account for the largest share of carbon dioxide emissions (40%), a greenhouse gas, and nitrogen oxide emissions (49%), a key precursor pollutant for ground level ozone. Given these realities along with Connecticut's aggressive greenhouse gas reduction targets, the state must evaluate additional measures to reduce emissions from motor vehicles and the transportation sector. Two strategies, which may significantly curb emissions quickly and cost effectively, include adopting of the California aftermarket catalytic converter rule, and expanding the I/M program to include heavy duty diesel trucks. Failing to effectively reduce transportation

emissions and meet our federal air quality goals may require the imposition of additional and even more severe, control measures in the future, like reduced speed limits or congestion pricing. Therefore, it is imperative to view the effectiveness of the existing I/M program against the back drop of likely additional control programs necessary to achieve Connecticut's short term and long term air quality goals.

This report focuses on the effectiveness of Connecticut's I/M program. Key program highlights include:

- In 2014, over 99% of the vehicles subject to testing were in compliance with I/M program requirements. The overall compliance rate in Connecticut exceeds the compliance rate of 96% specified in Connecticut's State Implementation Plan (SIP). Connecticut actively investigates non-compliance and assesses fines for late inspections. In 2014, 162,311 fines were assessed for late inspections. Linking registration to compliance in addition to late inspection fines contribute to Connecticut's very high compliance rate.
- Approximately 10% of vehicles failed their initial emissions test and 12% of these vehicles also failed their first retest in 2014. Failure rates under the decentralized I/M program are equal to or higher than failure rates recorded under centralized I/M programs. Ongoing efforts designed to decrease failure rates, such as incorporating the I/M program contractor's (Applus) Data Acquisition Device to enhance vehicle communication should offer solutions to emerging challenges, such as testing plug in hybrid electric vehicles.
- DMV and Applus perform extensive quality assurance checks on the program. Evaluation of these quality assurance data demonstrates that the program performs accurate inspections.
- Connecticut's anti-fraud efforts are models for other I/M programs. Connecticut conducted audits at all stations as part of an extensive anti-fraud program. For example, Connecticut conducted 1,529 video surveillance audits and 775 covert audits during 2014. Covert audits addressed On-Board Diagnostics (OBD), Acceleration Simulation Mode (ASM) and Pre-Conditioned Two Speed Idle (PCTSI) inspection performance. In addition, DMV and Applus run extensive trigger reports. Less than 0.10% of the inspections in Connecticut are suspect, which is far lower than the "suspect test" rate in most other states' I/M programs.
- DMV's fleet testing program is transitioning to a new vendor, Applus to correct challenges faced by the previous equipment. DMV expects that full implementation of the new fleet program will be completed during the first half of 2016.

Connecticut consistently conducts thoughtful analysis of its vehicle inspection and maintenance program, which has led to numerous enhancements. In the past year, improvements were implemented in the areas of training, emissions database, testing equipment and auditing. A full iteration of the changes to the program can be found in this report. Connecticut's analysis repeatedly has demonstrated the program effectively produces air pollutant reductions. DEEP and DMV continue to evaluate opportunities to improve the program and cost effectively increase the air quality benefits.

1.0 Introduction

This report presents an analysis of data collected in Connecticut's Motor Vehicle Inspection and Maintenance (I/M) program in 2014 to meet the United States Environmental Protection Agency's (EPA) annual reporting requirements of 40 CFR Part 51.366. In an I/M program, vehicles are periodically inspected, and those with evidence that they exceed design emission standards must be repaired. I/M programs are mandated by the Clean Air Act and were limited to areas that EPA designated as "serious" or "severe" non-attainment for the ozone National Ambient Air Quality Standard (NAAQS). Connecticut's program, which dates back to 1983, has a long history of effectively reducing vehicle emissions and is an important part of the strategy to ensure that Connecticut is positioned to attain the NAAQS for ozone. Since Connecticut's ozone levels exceed the 2008 Ozone NAAQS, additional emission reductions from all sectors, including motor vehicles, remain critical.

Connecticut's I/M program results in more emission reductions than any other state implemented reduction strategy. Estimates indicate that in 2010, this program would have resulted in approximately 19 of the 200 tons per day of air pollutant reductions that are included in Connecticut's Attainment Demonstration for the 1997 Ozone NAAQS¹. The emissions reductions resulting from this program are an integral part of Connecticut's air quality attainment efforts and important as part of a cost effective and balanced strategy that includes reductions from stationary, area and mobile source sectors.

Emissions reduction determinations are estimated using modeling that is approved by the EPA. The most recent State Implementation Plan (SIP) Revision, which addresses the I/M program, was developed using MOBILE6.2, the model which was approved for use by EPA at that time. EPA has since updated its modeling platform and now requires states to use the Motor Vehicle Emissions Simulator (MOVES) for attainment demonstrations, hot spot analysis and transportation conformity.

Connecticut's I/M program identifies vehicles that have been tampered with, or have received improper maintenance. These vehicles must be repaired until they comply with emission standards. The Connecticut Department of Motor Vehicles (DMV) oversees the I/M program operated by a private contractor; the Connecticut Department of Energy and Environmental Protection (DEEP) ensures that the program achieves the air quality benefits as outlined in Connecticut's SIP.

The original program implemented in 1983 subjected vehicles to two inspections – an idle test where exhaust concentrations of hydrocarbons (HC) and carbon monoxide (CO) were measured while the vehicle was idling and a visual inspection for the presence of the catalytic converter. Vehicles with gross vehicle weight ratings (GVWR) of 10,000 pounds (lbs.) or less were included in the program. In 1998, Connecticut

¹ Connecticut's Attainment Demonstration for the 1997 Ozone NAAQS details Connecticut's strategies designed to bring the state's air quality into compliance with the 1997 8-hour ozone NAAQS of 84 ppb.

substantially enhanced its existing I/M program to meet new SIP requirements, as well as federal requirements for I/M improvements. The emission test changed from an unloaded idle emission test to a loaded-mode test (ASM2525²). With this change, Connecticut began evaluating emissions of oxides of nitrogen³ (NO_x) along with HC and CO. The loaded-mode test uses a chassis dynamometer to simulate on-road driving. If the vehicle could not be safely tested on a dynamometer, it received a pre-conditioned two-speed idle (PCTSI) test. In addition, the inspection included a gas cap pressure test to check to see if the gas cap holds pressure. Leaking gas caps are a major source of evaporative HC emissions. The program continued to include a visual emission control component check. Also, at this time Connecticut began diesel testing.

In 2003, Connecticut again made substantial revisions to the program. The inspection network was changed from a centralized system with about 25 inspection stations to a decentralized system with a contractor equipped limit of 300 stations⁴. The goals of these changes were to improve customer convenience to the public by decreasing the waiting time for emissions testing, directly involve the repair industry with emissions testing, and enhance opportunities for small business development. In addition, 1996 and newer gasoline-powered models started receiving on-board diagnostic (OBD) tests⁵, instead of ASM2525 or PCTSI exhaust emissions tests. All 1996 and later model year light-duty vehicles sold in the United States contain the second generation of OBD, termed OBDII. Connecticut also performs OBD tests on diesel powered vehicles that are model year 1997 and newer having a GVWR of 8500 lbs. and less. OBDII systems can detect malfunctions or deterioration of emission control components, often well before the motorist becomes aware of any problem. Inspecting vehicles by reading the OBDII system codes can identify vehicles with serious emission control malfunctions more accurately and cost-effectively than traditional tailpipe tests, and help technicians diagnose and repair those malfunctions. Diesel powered vehicles having a GVWR of 10,000 lbs. or less, receive tests for excessive exhaust smoke, if they cannot receive OBDII tests. Evaluating OBDII test results presents special challenges, since tailpipe emission results are not available for each vehicle.

In 2011, the state embarked upon a new program with upgraded equipment and computer systems to correct challenges faced by the previous system. While the new program introduced many improvements, as part of this new program, DMV is working with their contractor, Applus, to evaluate and implement additional new improvement

2 The ASM2525 or Acceleration Simulation Mode test measures HC, CO and NO emissions while the vehicle is driven at a constant speed (25 MPH) on a treadmill-like device termed a dynamometer.

3 Nitric oxide (NO) is measured as a surrogate for oxides of nitrogen (NO_x). NO_x along with HC emissions are considered to be the major ozone precursors.

4 This number dropped from 300 stations to 250 stations by the end of 2008. At the end of 2014, there were 222 stations in the network.

5 1997 and newer light-duty diesels (<8500 lbs. GVWR) also get OBD inspections.

measures to maximize the cost effectiveness and air quality benefits of the program.

The methodology for this report has utilized data on different inspection components to determine if the appropriate number of vehicles are being failed and repaired. This multifactorial approach is consistent with the purpose of the OBDII system, since it assures that Connecticut is identifying, and requiring the repair of vehicles that exceed design emission standards by more than 50%, as required by the EPA. Evaluating decentralized inspections requires a comprehensive assessment of how well stations comply with mandated inspection procedures. Generally, there are greater opportunities for fraud in decentralized facilities, because there are more stations that need policing. Using data and procedures provided by the DMV, de la Torre Klausmeier Consulting, Inc. (dKC) assessed effectiveness and enforcement of Connecticut's program.

2.0 Observed Failure Rates for Gasoline-Powered Vehicles

Failure rates for gasoline-powered vehicles were calculated using test results from I/M test stations. Below is a brief description of the criteria used to determine if a vehicle passes or fails inspection.

Pass/Fail Criteria

ASM2525 or Pre-Conditioned Two-Speed Idle (PCTSI) Inspection (pre-1996 vehicles): Vehicles fail if they exceed Connecticut's cut points or emissions standards. For the ASM2525 test, HC, CO and NOx emissions are evaluated. For the PCTSI test, HC and CO emissions are evaluated. Connecticut uses EPA's recommended cut points for the ASM2525 and PCTSI tests.

Gas Cap Test: Vehicles fail if their gas cap cannot hold pressure. Beginning in November 2004, only pre-1996 light-duty vehicles receive gas cap tests. The OBDII system adequately tests a vehicle's evaporative system on most 1996 and newer vehicles.

OBDII Inspection: 1996 and newer light-duty vehicles are subject to an OBDII inspection. The emissions test system is plugged into the OBDII connector and information on the status of the vehicle's OBD system is downloaded. Vehicles fail the OBDII inspection if they have the following problems:

- Malfunction Indicator Lamp (MIL⁶) is commanded-on;
- MIL not working (Termed Key-On Engine-Off, KOEO, failure⁷);
- The number of readiness monitors that are not ready exceed EPA's limit⁸;
 - 1996-2000 models: Two monitors are allowed to be not ready;
 - 2001+ models: One monitor is allowed to be not ready;
- OBD Diagnostic Link Connector (DLC) damaged; or
- Vehicle could not communicate with the Connecticut inspection system.

6 MIL is a term used for the light on the instrument panel, which notifies the vehicle operator of an emission-related problem. The MIL is required to display the phrase "check engine" or "service engine soon" or the ISO engine symbol. The MIL is required to illuminate when a problem has been identified that could cause emissions to exceed a specific multiple of the standards the vehicle was certified to meet.

7 The Key-On Engine-Off (KOEO) determines if the MIL bulb is working. The bulb should illuminate when the vehicle is turned on but not started.

8 OBDII systems have up to 11 diagnostic monitors, which run periodic tests on specific systems and components to ensure that they are performing within their prescribed range. OBDII systems must indicate whether or not the onboard diagnostic system has monitored each component. Components that have been diagnosed are termed "ready", meaning they were tested by the OBDII system.

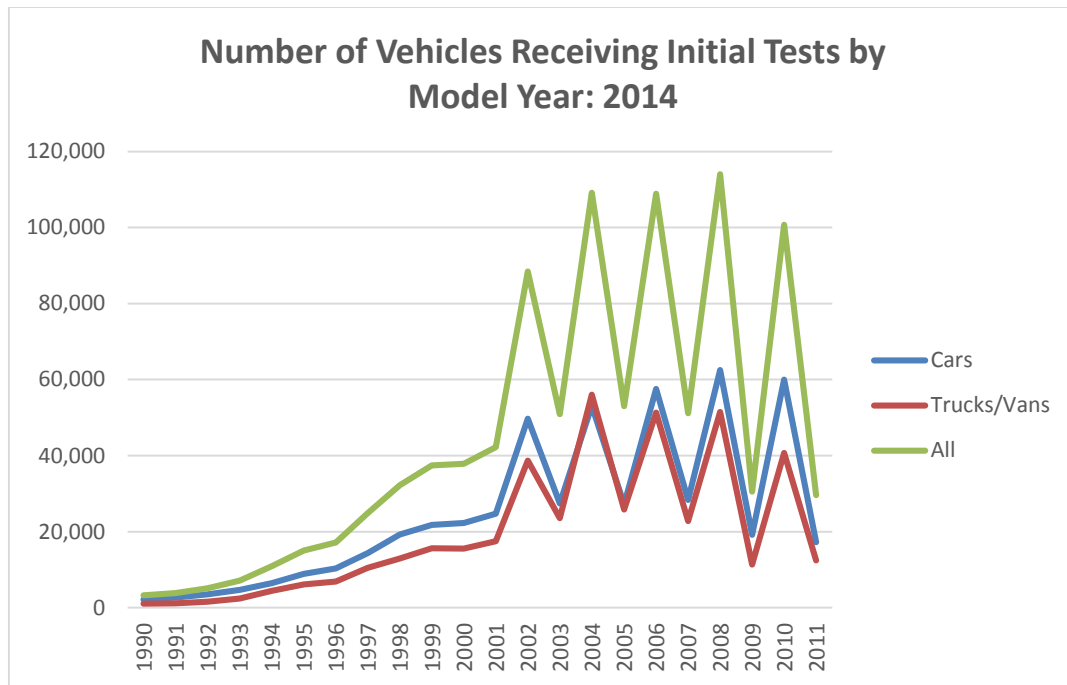
Summary of Fail Rates for Gasoline-Powered Vehicles

Following is a summary of test results from January 1, 2014 to December 31, 2014. In 2014, 959,921 gasoline-powered vehicles received initial tests.

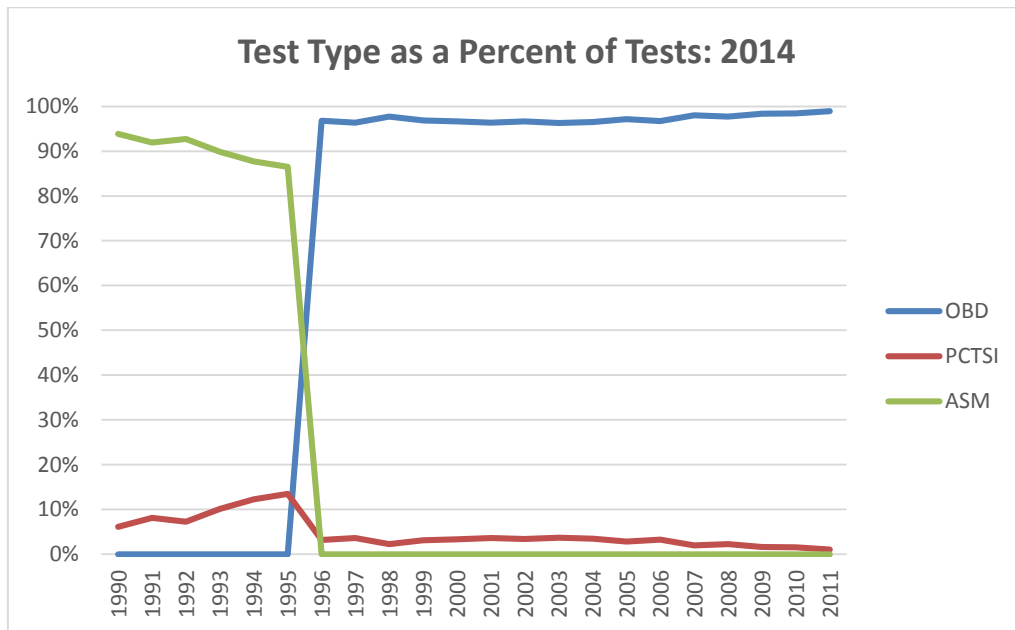
Test Type	Parameter	2014 Result
OBD	% Fail Initial (any reason)	10.2%
	% Fail for MIL Commanded-on	5.3%
	% Fail First Retest	10.9%
ASM	% Fail Initial	14.0%
	% Fail First Retest	27.5%
PCTSI	% Fail Initial	8.9%
	% Fail First Retest	14.5%
Gas Cap	% Fail Initial	6.3%
	% Fail First Retest	7.3%
All Tests	% Fail Initial	10.3%
	% Fail First Retest	12.1%

Conclusion: These failure rates are comparable to results in previous years. Failure rates in Connecticut's I/M program are in line with those reported in Test-Only programs⁹. Test-Only programs generally are considered by EPA to be the model for peak I/M performance. Based on failure rates, Connecticut's I/M program is failing an appropriate number of vehicles.

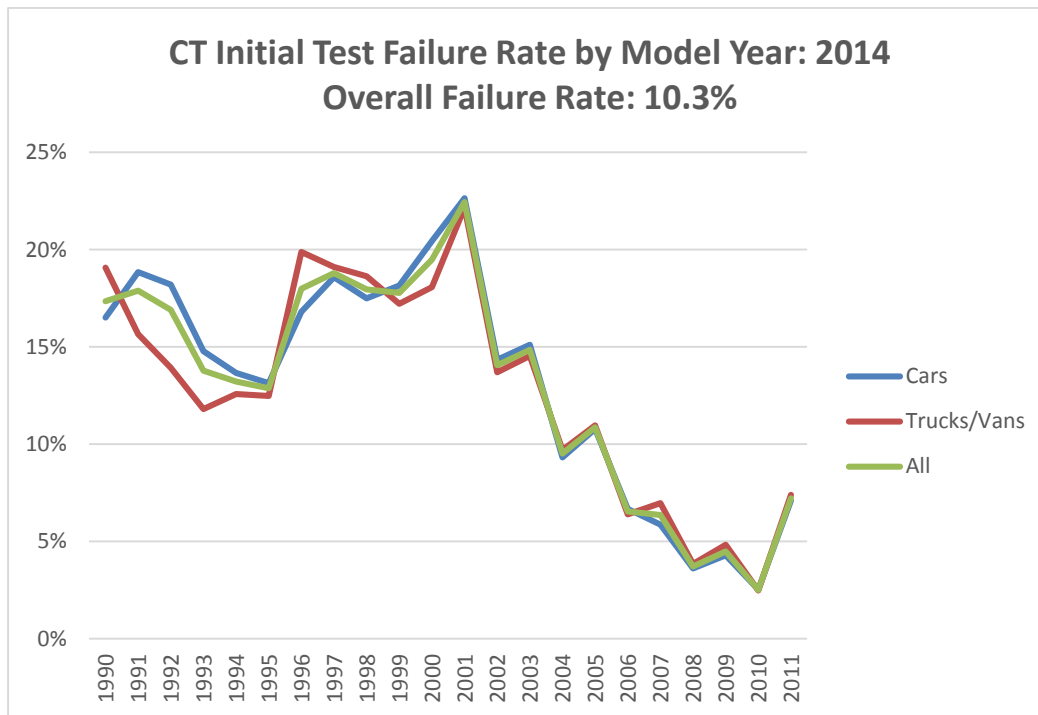
⁹ At the end of this section is a chart that compares failure rates for the OBD test in Connecticut with failure rates in Delaware. Delaware is a well enforced Test-Only I/M program. Failure rates in both programs are nearly identical.



This chart shows the total number of inspections by vehicle model year, and vehicle type. The first four vehicle model years are exempted from testing, so the number drops sharply after the 2011 model year. All vehicles have a 10,000 lbs. or less GVWR.

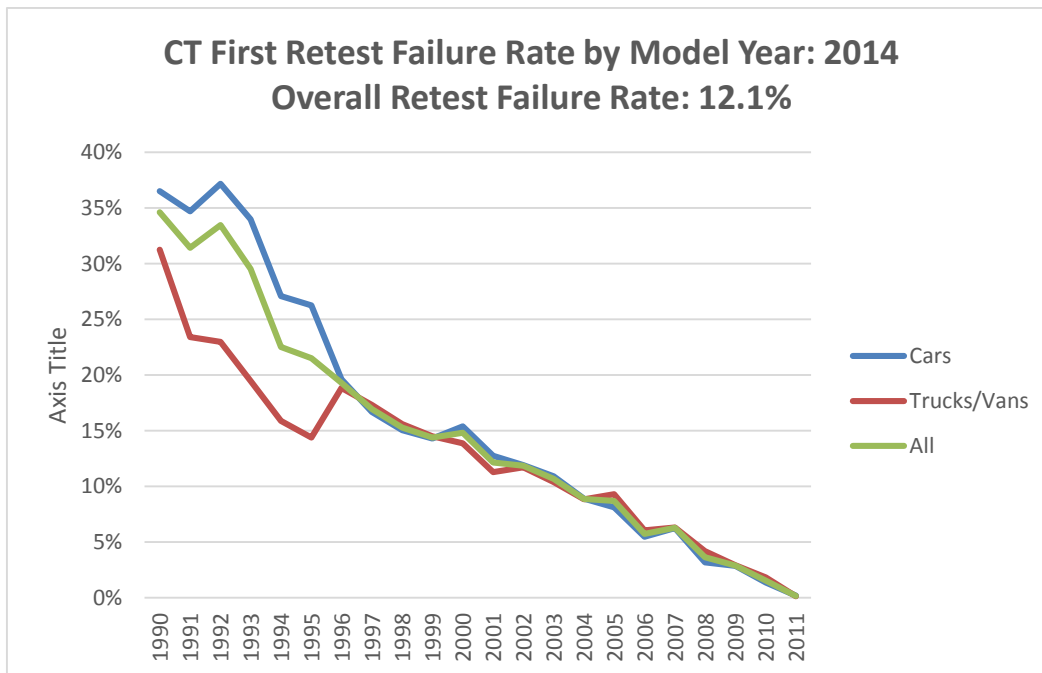


This chart shows the total number of inspections by vehicle model year and final inspection type. Most 1996+ vehicles received OBDII tests. A small percent (2%) of the vehicles newer than 1996 were models over 8500 lbs. GVWR without OBD systems.

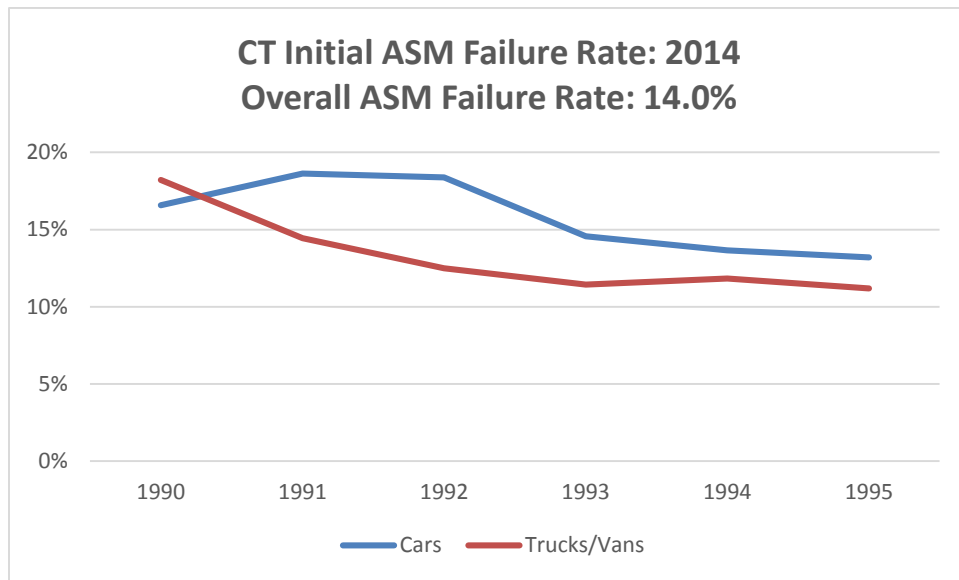


This chart shows the overall percentage of vehicles that failed the tailpipe test, gas cap test, visual emission control component test, or the OBD test. Some vehicles failed more than one inspection component. As expected, the failure rate is generally lowest for new vehicles. Following the pattern seen previously, the failure rate for cars and trucks spiked upwards for 1996 model year vehicles, due to increased stringency associated with the implementation of the OBDII test. Compliance with the OBDII test is considered to be more difficult than compliance with the ASM2525 or PCTSI test. The failure rate is consistent with failure rates reported in test-only programs in other jurisdictions. EPA requires that 2001 and newer model year vehicles have, at most, one monitor not ready as opposed to two for 2000 and older model year vehicles. This change in readiness requirement explains the elevated failure rate for 2001 model year vehicles. The high initial failure rate for 2011 model year vehicles is due to the fact that over half of these vehicles tested had dealer plates. Vehicles owned by dealers typically have high not ready rates because their batteries are often insufficiently charged, or had been disconnected during dealer prep¹⁰.

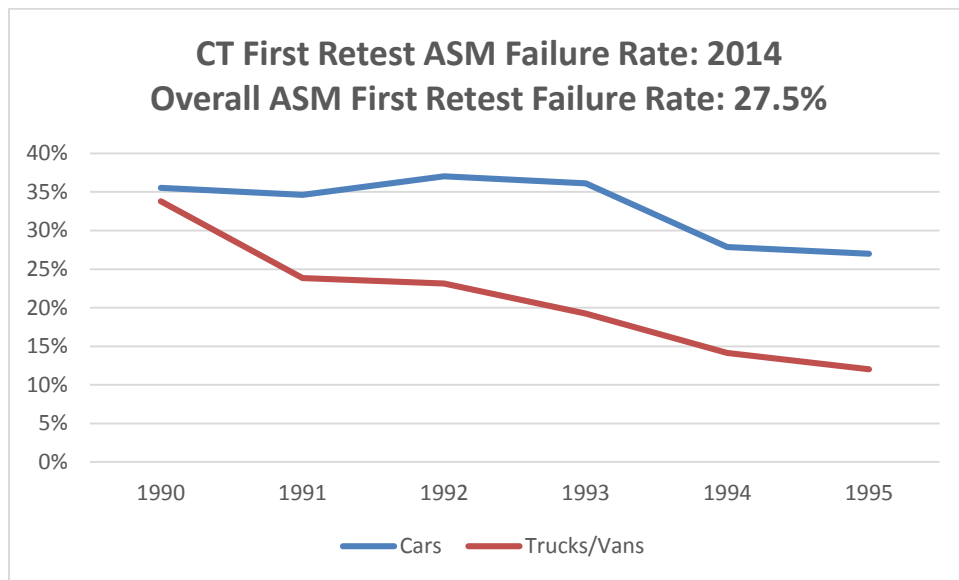
¹⁰ Readiness status for all monitors usually sets to not ready when a vehicle's battery is disconnected.



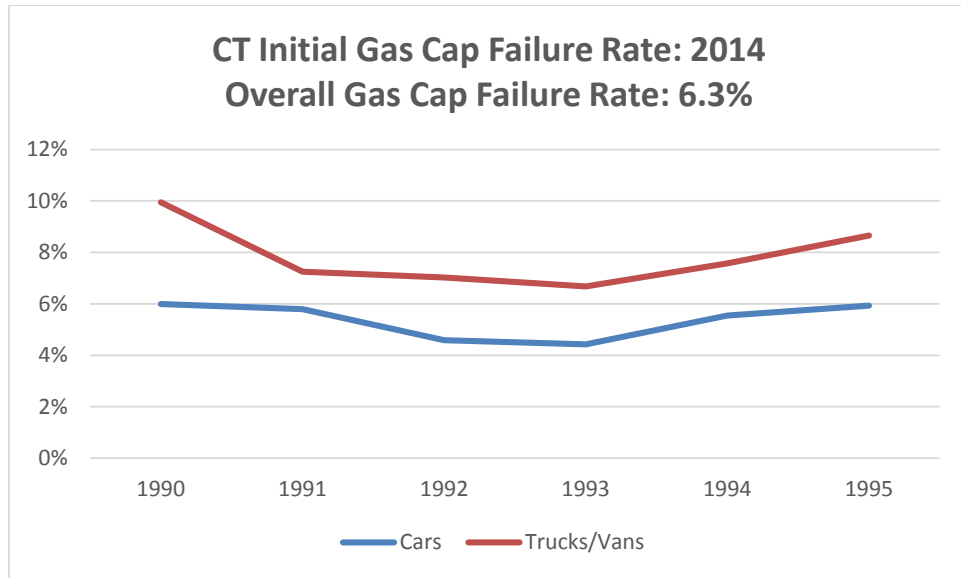
This chart shows the percent of vehicles by model year that failed their first retest. The failure rate is highest for the older model year vehicles, which is typical. Overall, 12.1% of the vehicles tested failed their first retest.



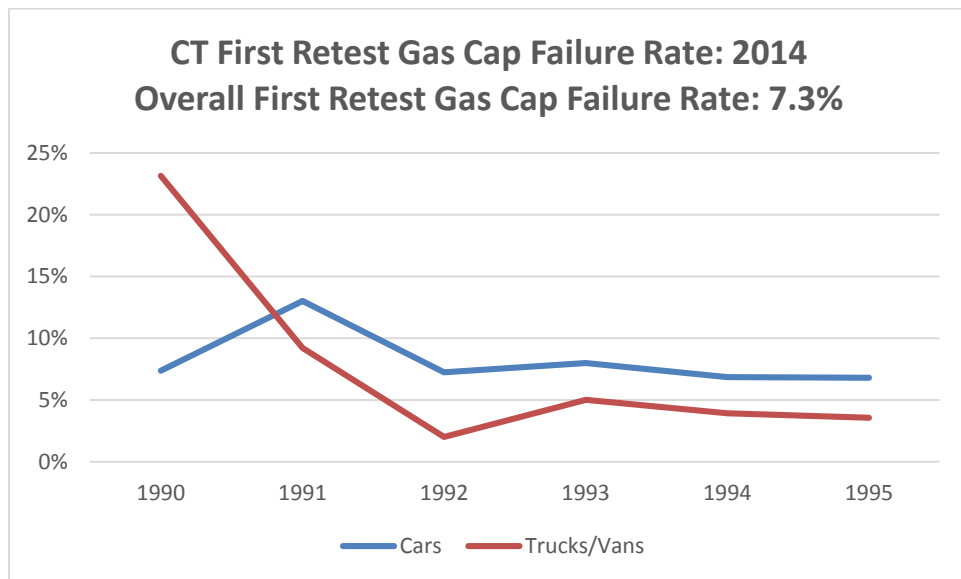
This chart shows failure rates by vehicle model year for the ASM test. The average ASM test failure rate for all vehicles was 14.0%. 1996 and newer model year vehicles received OBDII tests.



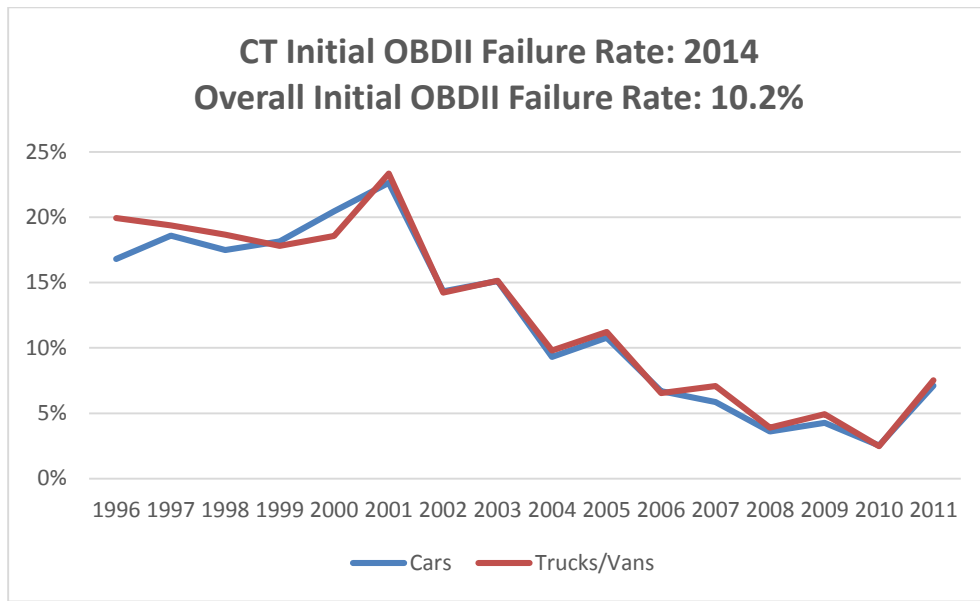
This chart shows the percentage of vehicles by vehicle model year that failed their first ASM retest. Overall, 27.5% of the vehicles failed the first ASM retest.



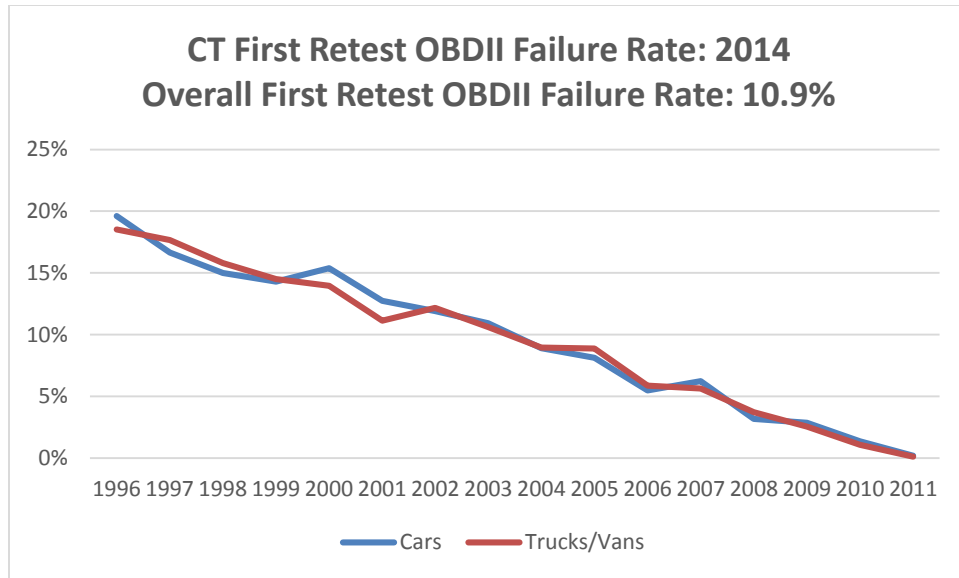
This chart shows the gas cap pressure test failure rate by vehicle model year. Overall, 6.3% of the vehicles that receive gas cap tests fail the test. 1996 and newer light-duty vehicles no longer receive gas cap tests.



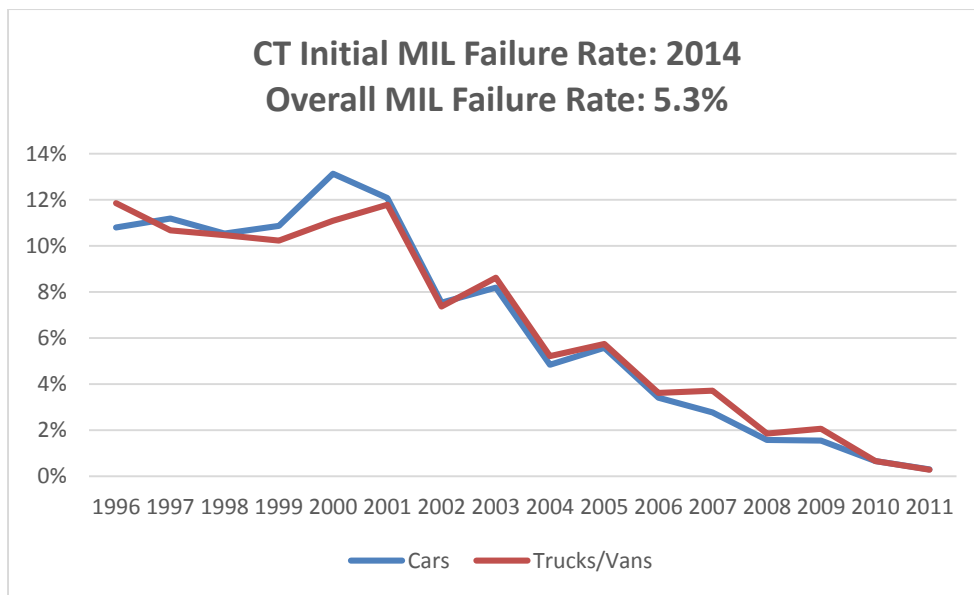
This chart shows the gas cap retest failure rate by vehicle model year. Overall, 7.3% of the vehicles that failed their initial gas cap test fail the first gas cap retest.



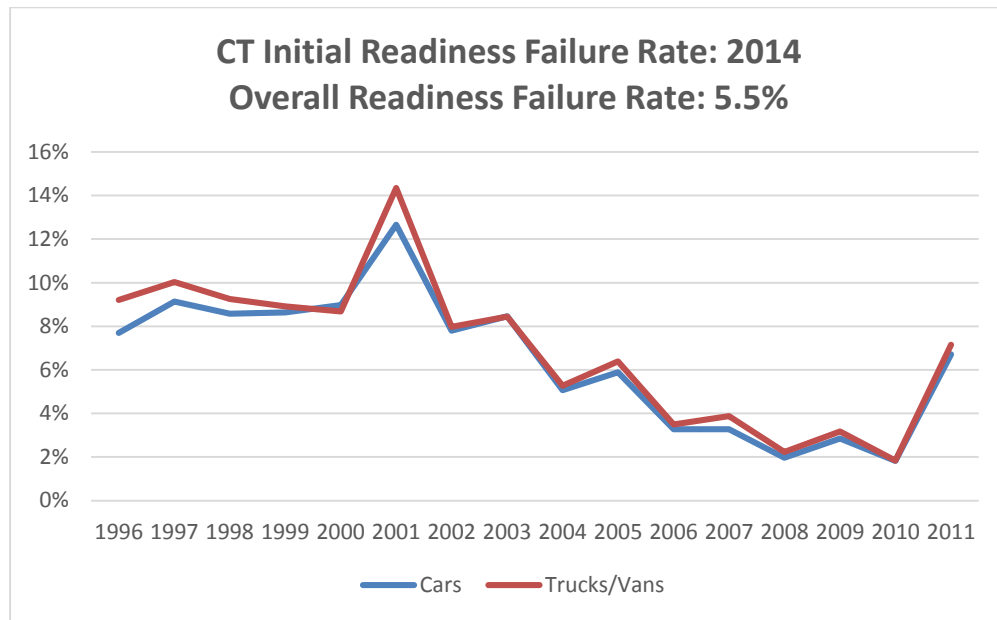
This chart shows failure rates by vehicle model year for the OBD test. The average OBD test failure rate for all vehicles was 10.2%. Typically, a higher failure rate for older model year vehicles is expected. 18% of the 1996 model year vehicles failed the test. EPA requires that the 2001 and newer model year vehicles have at most one monitor not ready as opposed to two for 2000 and older model year vehicles. This change in readiness requirement explains the slightly elevated failure rate for 2001 model year vehicles. The increase in failure rates for 2011 model year vehicles reflects a high “not-ready” rate for these models. The high initial failure rate for 2011 model year vehicles is due to the fact that over half of these vehicles had dealer plates. Vehicles owned by dealers typically have high not ready rates, because their batteries are often insufficiently charged, or had been disconnected during dealer prep.



This chart shows failure rates by vehicle model year for the first OBD retest. The average failure rate for all vehicles in the first OBD retest was 10.9%. Connecticut requires OBD failures to meet readiness requirements when retested. If a vehicle does not meet readiness requirements when retested, the inspection is aborted. Vehicles that are not ready on retest are not included in the above failed percentages.

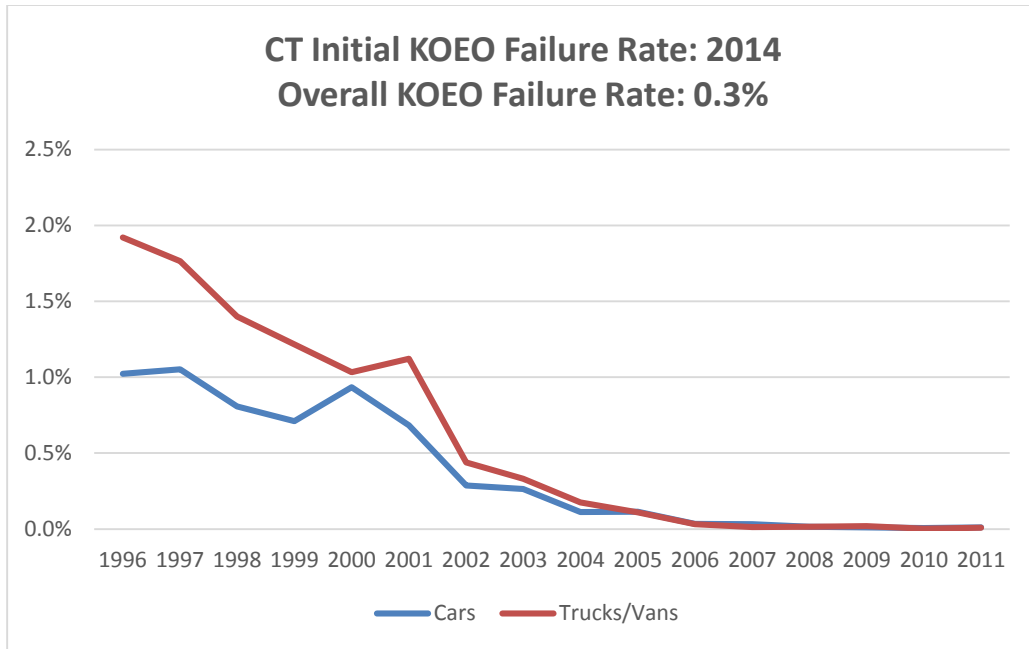


This chart shows the percentage of vehicles that fail the MIL Command check that's part of the OBD test. About half of the OBDII failures are for the MIL Command check. The average MIL failure rate for all vehicles was 5.3%. This graph shows that older model year vehicles have a higher failure rate, as expected.

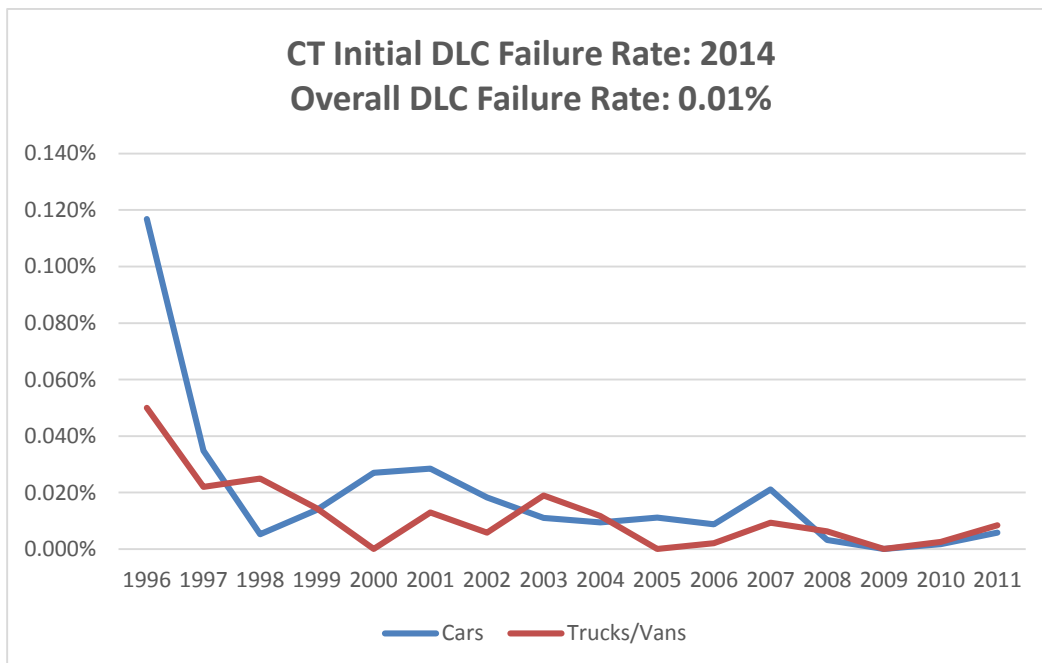


This chart shows the percentage of vehicles that exceed EPA’s readiness criteria. OBDII systems must indicate whether or not the onboard diagnostic system has monitored each component. Components that have been diagnosed are termed “ready”, meaning they were tested by the OBDII system. EPA requires that 2001 and newer model year vehicles have at most one monitor not ready as opposed to two for 2000 and older model year vehicles. This change in readiness requirement explains the elevated failure rate for 2001 model year vehicles. The high “not ready” rate for 2011 models is due to the fact that over half of the 2011 vehicles tested, had dealer plates. Vehicles owned by dealers typically have high not ready rates, because their batteries are often insufficiently charged, or had been disconnected during dealer prep¹¹. Overall, 5.5% of the vehicles failed EPA’s readiness criteria.

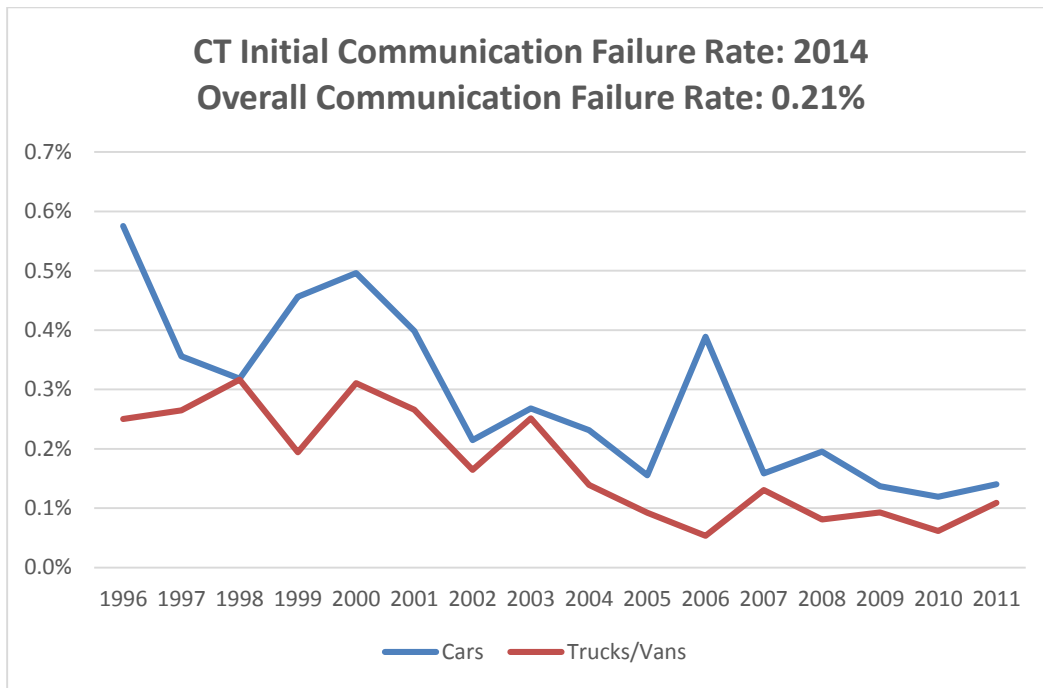
¹¹ Readiness status for all monitors usually sets to not ready when a vehicle’s battery is disconnected.



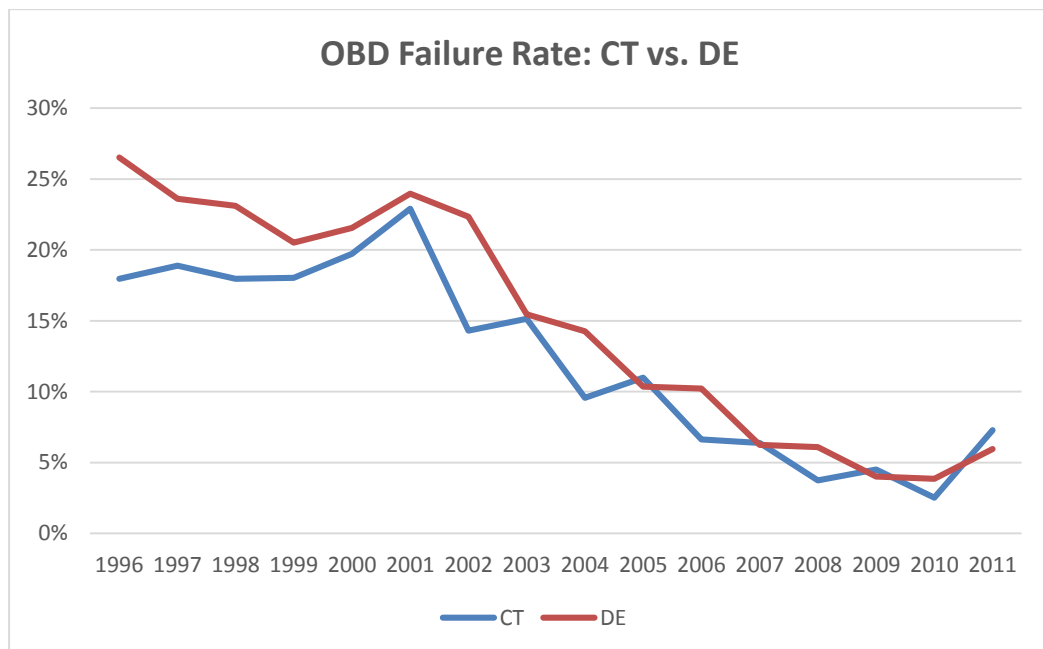
This chart shows failure rates by vehicle model year for the Key-On Engine-Off (KOEO) test, which is part of the OBD test. The KOEO determines if the MIL bulb is operational. The bulb should illuminate when the vehicle is turned on, but not started. The average KOEO failure rate for all vehicles was 0.3%.



This chart shows the percentage of vehicles that failed because the OBDII connector, termed the Data Link Connector or DLC, is missing, damaged or obstructed. Overall, few vehicles (0.01%) failed for this reason.



This chart shows the percentage of vehicles that failed to communicate with the OBDII test equipment. Overall, 0.21% of the vehicles failed for this reason.



This chart compares failure rates for the OBDII tests in Connecticut and Delaware. Delaware is a state-operated test-only program, which is considered by EPA to be a model for peak I/M performance. Failure rates in both programs are similar, which indicates that Connecticut's I/M program is failing an appropriate number of vehicles.

3.0 Observed Failure Rates for Diesel-Powered Vehicles

Diesel-powered vehicles with a GVWR of 10,000 lbs. or less are also tested in Connecticut's I/M program. Although the testing and reporting of diesel-powered vehicles is not required, historically Connecticut has reported on diesel testing. This report and Appendix B includes additional information on diesel initial testing, first retest as well as second and later retesting. If the vehicle is equipped with an OBDII system, an OBDII test is performed. Otherwise, the vehicle receives a test designed to identify excessive exhaust smoke opacity.

Failure rates for diesel-powered vehicles were calculated using test results from I/M test stations. Below is a brief description of the criteria used to determine if a vehicle passes or fails inspection.

Pass/Fail Criteria

Modified Snap Acceleration (MSA) Test: With this test, the throttle is "snapped" (i.e., accelerator is quickly pressed and then released) and exhaust smoke opacity is measured. This test is performed with the vehicle being in "neutral". The average of three snaps is calculated, and compared to the standard recommended by the federal government.

Loaded Mode Diesel (LMD) Test: Vehicles are tested using a dynamometer to simulate driving at 30 mph. Exhaust smoke opacity is measured.

OBDII Inspection: 1997 and newer model year diesel vehicles with GVWR of 8500 lbs. or less receive an OBDII inspection. The emissions test system is plugged into the OBDII connector and information on the status of the vehicle's OBD system is downloaded. Diesel-powered vehicles will fail the OBDII inspection if they have any of the following problems:

- Malfunction Indicator Lamp (MIL) is commanded-on and DTCs are stored;
- MIL not working (Termed Key-On Engine-Off, KOEO, failure);
- OBD diagnostic link connector damaged, missing or obstructed; and
- Excessive readiness monitors not ready based on the model year

Summary of Failure Rates for Diesel-Powered Vehicles

Following is a summary of test results for the January 1, 2014 to December 31, 2014 period. In 2014, 9,929 diesel-powered vehicles received opacity tests, and an additional 4,028 vehicles received OBD tests.

Test Type	Parameter	2014 Result
OBD	% Fail Initial	10.2%
	% Fail First Retest	6.3%
MSA	% Fail Initial	6.7%
	% Fail First Retest	28.8%
LMD	% Fail Initial	1.3%
	% Fail First Retest	1.3%

Appendix B has details on the OBD, MSA, and LMD test results for diesel and gasoline powered vehicles.

Conclusion: These failure rates are similar to rates found in previous evaluation reports. Outside of Connecticut, few states perform periodic tests on diesel-powered vehicles, so there is little basis for a comparison of Connecticut's diesel-powered vehicle failure rate with failure rates in other states.

4.0 Enforcement of Connecticut's I/M Program

Connecticut's program uses both registration denial and late fee assessment to assure compliance. This section presents an analysis of data relevant to the enforcement of Connecticut's I/M program. Statistics required by 40 CFR 51.366 are presented below, and in the Appendix B, with exception of 40 CFR 51.366(d)(1)(iv) and (v) which are not applicable to Connecticut's program.

Overall Compliance Rate

The overall compliance rate is based on an audit of registered vehicles. Connecticut committed to a 96% compliance rate for the vehicles subject to I/M requirements in the SIP. In 2014, 960,366 registration renewals were audited, resulting in 52,987 denials, of which 93.5% later complied. This works out to a 99.6% compliance rate, so the overall compliance rate exceeds the compliance rate specified in the SIP.

Late Fees: In 2014, 162,311 late fees were assessed for total fines to motorists of \$3.2 million. These fines serve as an effective motivation for compliance with inspection requirements.

Preventing Circumvention of Connecticut's I/M Requirement

EPA requires states to prevent motorists from avoiding I/M requirements by falsely registering vehicles out of the program area, or falsely changing fuel type or weight class on the vehicle registration. EPA also requires states to report on results of special studies to investigate the frequency of such activity.

- **Circumventing I/M Tests in Connecticut** – Circumventing I/M tests in Connecticut is nearly impossible. First, Connecticut implements the I/M program on a statewide basis. Second, Connecticut tests all fuel types, including hybrids, so motorists cannot avoid inspection by changing fuel type. It may be possible to avoid inspection by registering the vehicle with a GVWR greater than 10,000 lbs., but likely is limited in scope due to the added expense. The majority of vehicles registered with an incorrect GVWR are those where the vehicle owner registers the vehicle at a lower weight to avoid the added expense and would not be emission eligible (>10,000 lbs.) with their corrected weight.
- **Detection and enforcement against motorists that falsely change vehicle classifications to circumvent program requirements** – Historically, 99% of emission eligible vehicles in Connecticut are in the Passenger, Commercial or Combination classifications. Incidents of motorists modifying a vehicle's registration classification to a non-emission eligible class are rare, most likely because of the added expense, documentation and inspection requirements.
- **Vehicles registered in Connecticut that are operated out-of-state** – DMV took a random sample of approximately 20-25 time extension requests, to ascertain whether these vehicles had received numerous time extensions. As a result, it was found that many of the requests had received multiple time

extensions. Accordingly, DMV changed its policy so that it now complies with the intent of the extension. Specifically, under its current procedures, DMV will not allow a vehicle owner to receive numerous time extensions. These efforts are definitely helping to make vehicles registered in Connecticut emissions compliant. DMV assumes that vehicles are scrapped or registered out-of-state if they do not comply with I/M requirements.

Percent of Failed Vehicles That Ultimately Pass

To estimate whether *vehicles that failed their emissions test ultimately pass*, the fate of vehicles failing the I/M test in 2014 was evaluated. As Connecticut has done in previous reports per EPA recommendations, these results are calculated as the percentage of vehicles with no known final outcome as compared to vehicles that initially failed and do not receive a final pass.

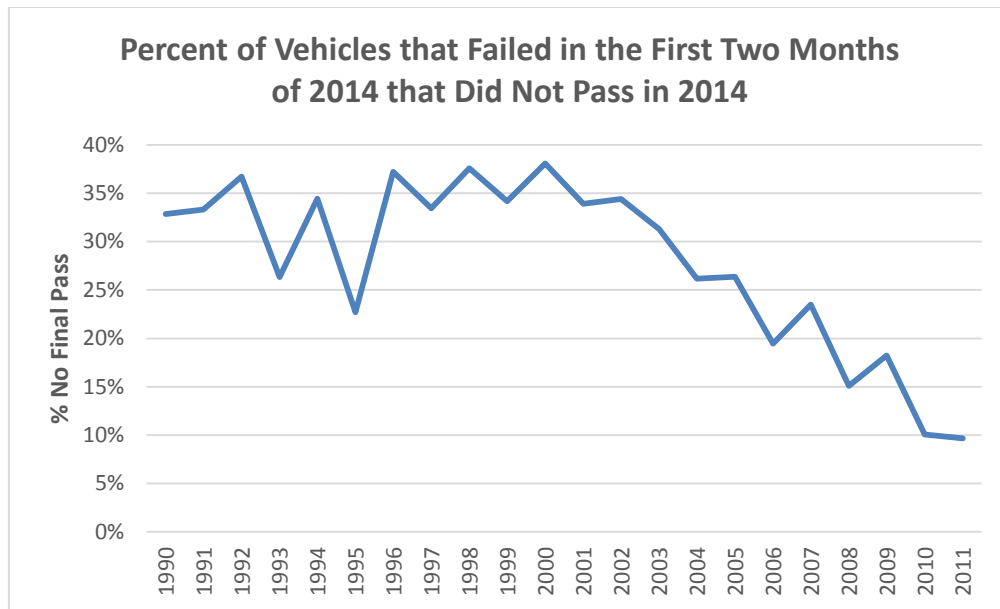
Failures for the first two months of 2014 were tracked through December 31, 2014. Results are shown in the table and figure below. Twenty nine percent of the failures during this two month period had not yet received a passing result or waiver. As noted in Appendix B, section (a) (2) (vi), the number of vehicles that passed retests equaled 81% of the number of failures in 2014¹². Ultimately, all vehicles must comply, or they cannot be registered in Connecticut, since I/M compliance is a prerequisite for vehicle registration. As noted above, Connecticut levied \$3.2 million in fines for late inspections. Overall, over 99% of the vehicles that were tested complied with I/M program requirements.

EPA's comments on the 2012-2013 Biennial Evaluation Report encourages states to improve the program performance by reducing the number of vehicles with no final outcome. This year's evaluation found that 19% of the failed vehicles had not successfully passed emissions testing by the end of 2014. To avoid vehicles that fail in a state with a strong enforcement program, such as Connecticut's, from subsequent re-registration, perhaps in a different state/area with more relaxed testing requirements, EPA suggests that state/areas with I/M programs consider developing Vehicle Identification Number (VIN)-based databases for vehicles that fail I/M tests and do not receive final passing results. Connecticut looks forward to EPA's leadership in developing partnerships with the other jurisdictions to improve the program by addressing the number of vehicles with no final outcome.

¹² The number of vehicles that passed retests in 2014 included vehicles that failed in 2013.

**Vehicles Tested from 1/1/14 to 3/1/14
with No Known Outcome**

Model Year	Initial Fail	Final Retest Pass	No Final Pass	% No Final Pass
1990	70	47	23	33%
1991	123	82	41	33%
1992	147	93	54	37%
1993	148	109	39	26%
1994	212	139	73	34%
1995	370	286	84	23%
1996	470	295	175	37%
1997	894	595	299	33%
1998	849	530	319	38%
1999	1,232	811	421	34%
2000	1,192	738	454	38%
2001	1,509	997	512	34%
2002	1,276	837	439	34%
2003	1,281	880	401	31%
2004	1,498	1,106	392	26%
2005	884	651	233	26%
2006	1,079	869	210	19%
2007	579	443	136	23%
2008	617	524	93	15%
2009	236	193	43	18%
2010	438	394	44	10%
2011	486	439	47	10%
TOTAL	15,590	11,058	4,532	29%



This chart shows the percentage of vehicles that failed the emission test in the first two months of 2014 that did not have a passing result in 2014. The increase from the 1995 to 1996 model year indicates that compliance with the OBD test may be more difficult than the tailpipe test used for pre-1996 vehicles. Ultimately, all of these vehicles must pass to be registered in Connecticut.

Waivers Issued

Another metric related to program efficacy is the number of waivers issued. Program effectiveness is inversely proportional to the waiver rate. As the following table shows, less than 0.2% of the vehicles that failed received waivers, indicating that the program is effective. This is much lower than the waiver rate committed to in the SIP and also much lower than the rates in many other states' I/M programs. Connecticut's I/M SIP committed to a waiver rate of 1%.

% of Failed Vehicles Receiving Waivers¹³ in 2014

Model Year	Passenger Car (P)	Truck (T)	Total # of Waivers	# of Failed Vehicles	% of Failed Vehicles Receiving Waivers
1990	3	0	3	564	0.53%
1991	1	0	1	685	0.15%
1992	2	0	2	861	0.23%
1993	0	0	0	976	0.00%
1994	1	0	1	1441	0.07%
1995	4	0	4	1930	0.21%
1996	3	0	3	3032	0.10%
1997	7	6	13	4589	0.28%
1998	6	3	9	5740	0.16%
1999	7	3	10	6558	0.15%
2000	13	3	16	7291	0.22%
2001	18	7	25	9344	0.27%
2002	13	7	20	12269	0.16%
2003	12	7	19	7489	0.25%
2004	8	9	17	10282	0.17%
2005	6	6	12	5704	0.21%
2006	6	6	12	7053	0.17%
2007	5	0	5	3239	0.15%
2008	1	1	2	4232	0.05%
2009	0	0	0	1388	0.00%
2010	0	0	0	2664	0.00%
2011	0	0	0	2161	0.00%
Total	116	58	174	99,492	0.17%

¹³ Diagnostic and Cost waivers combined.

Waiver of late fees for special conditions

General Motors initiated a massive safety recall to address vehicle ignition switch problems. Public safety concerns called for the expedient repair of these vehicles. However, a delay in receiving the necessary parts, prompted Governor Dannel Malloy and DMV Commissioner Melody Currey to waive late inspection fees for owners of affected vehicles. Also, late fees were also waived due to severely inclement weather during the winter of 2013-14. DMV staff verbally reported that their review of records revealed that all of the vehicles receiving time extensions were ultimately tested and these testing results are incorporated into the program metrics. Statistics are summarized below:

- Total number of General Motors vehicles whose late fees were waived between April 9, 2014 and October 31, 2014: 792
- Total vehicles whose late fees were waived for inclement weather February 5 – 11, 2014: 86
- Total vehicles whose late fees were waived by for inclement weather February 13 – 22, 2014

Fleet equipment issues

Connecticut initiated a pilot fleet testing program in 2004, with two fleet testing stations: AT&T and Cablevision Systems Corporation. The program expanded in 2005 and 2006 to include additional fleet testing stations, including several municipalities and state agencies. The fleet program is voluntary and exists as a means to assist businesses by offering them the flexibility to test their own vehicles. However, DMV, in an attempt to formalize the program, suggested that the vendor offer maintenance contracts to support the fleet testing equipment. Thus, the vendor offered one and two year maintenance contracts.

Even though these maintenance contracts expired in 2007 and 2008, the vendor continued to maintain the equipment until 2013, when maintenance support decreased. One issue that arose in 2014, not addressed by the vendor, was a VIN decoding software glitch that would not allow the fleet analyzer to test vehicles newer than 2009. As a result, DMV reported issuing 106 six month time extensions to affected vehicles so they could be registered. Of the 106 time extensions, 83 were issued for the VIN decoding issue and 23 were issued because the fleet testing equipment was out of service for repair. Of the 106 vehicles that received time extensions, 12 were subsequently tested and passed. For the other vehicles which are not registered and therefore not subject to registration denial, such as municipal vehicles, DMV advised their fleet managers to wait until a resolution to the problem was implemented.

DMV began transitioning the fleet program to Applus with new equipment and a new database in 2013. The owners or operators of all fleets will be invited to participate in the revised fleet vehicle testing program. Once then new fleet program is implemented, fleet vehicles that are out of compliance will be tested in the new program. If an existing fleet facility does not participate in the new program, its fleet vehicles will revert to the standard I/M program.

There are currently (32) fleet test stations. Three of the existing state agencies and two new state police testing stations will receive new analyzers first. The remaining 29 fleet stations may then choose to participate in the new fleet program. Any non-exempt fleet vehicles no longer within the fleet program will be tested in the standard I/M program. , since the systems are linked. The transition time line for the fleet testing program is dependent on implementation of DMV's upgraded computer system. DMV expects that full implementation of the new fleet program will be completed during the first half of 2016. DMV is unable to determine the number of fleet vehicles that have not received timely emissions testing.

Two year waivers issued to plug-in hybrid electric vehicles due to testing equipment issues

Challenges presented by testing the General Motors 2011 model year Volt resulted in two year waivers being issued while Connecticut's emissions testing equipment is upgraded to accommodate these vehicles. DMV is working with Applus to adopt testing methods used in Applus equipment being operated in California.

In conclusion, Connecticut exceeds SIP requirements for enforcement of motorist compliance. The compliance rate in the Connecticut SIP is 96%. Connecticut actively investigates non-compliance, and assesses a large number of fines for vehicles that are not presented for emission inspection, in a timely manner.

Enforcement of Proper Test Procedures through Trigger Reports and Video Audits

Connecticut is a model for other states in how to enforce proper I/M test procedures. Connecticut actively looks for cases where inspectors may be performing improper inspections, passing vehicles that otherwise should fail. The following is a summary of how Connecticut ensures that stations perform proper inspections.

Trigger Audits

DMV and its contractor, Applus, run extensive trigger reports to assure that inspection stations follow proper test procedures. DMV requires Applus to maintain quality assurance measures, which they meet by conducting additional audits. Specifically, Applus performs a large number of digital audits and quality assurance reviews on a daily, weekly and monthly basis. Many of the reports are automated by the Applus MiniVID, and distributed, via email to DMV and Applus QA staff. In addition, the reports are available on the program dashboard for review at any time, and they are available for any time frame.

Trigger reports look for anomalies in data recorded during inspection. These reports help DMV identify stations performing fraudulent or inaccurate inspections. Triggers focus on finding the following types of fraud:

- Clean Scanning: Performing an OBDII test on a fault-free vehicle instead of the vehicle that should be tested;
- Clean Piping: Performing a tailpipe test on a passing vehicle instead of the vehicle that should be tested.

These reports are generated frequently to identify stations performing improper inspections. Connecticut promptly investigates all significant cases of possible inspection fraud. Following is a list of some of the trigger reports:

- OBD Testing Triggers:
 - All OBD Monitors Unsupported;
 - A/C Monitor Ready or Not Ready;
 - OBD Short Time Test, less than 30 minutes;
 - OBD VIN Mismatch;
 - Monitor Mismatch;
 - PID/PCM Mismatch;
- ASM/PCTSI Triggers:
 - ASM Short Time Test, less than 30 minutes;
 - Looser ASM Cut Points;
 - Vehicles with GVWR greater than 8,500 pounds;
- Other Triggers:
 - VIN Entry Type;
 - Inspector ID Entry;
 - Offline Percentage;
 - RPM Bypass;
 - No Saturday/Holiday Testing; and
 - Missing Video/Test Image.

Applus' MiniVID also generates the following automated alerts:

- Weather (temperature, humidity, pressure);
- EDBMS Offline;
- CDAS Offline;
- Test Center Not Testing; and
- Failed/Expired Calibrations Report.

A new quality assurance process was put in place to identify those stations that either perform the minimum amount of calibrations, or fail to contact Applus for service, when one of the calibrations fails. Each day, Applus performs a Failed/Expired Calibration Report to ensure that the entire network is in compliance with calibrations. Test Centers with failed calibrations, and no open service tickets, or facilities with expired calibrations are immediately locked out, to prevent use of the analyzer. This process was put in place to discourage Test Centers from waiting until a motorist arrives to complete the remaining calibration (ASM, PCTSI, opacity tests).

Special Triggers for Diesel Opacity Tests

All diesel-powered vehicles up to 10,000 lbs. GVWR are subject to the loaded mode opacity test utilizing the dynamometer. Because inspectors are accustomed to performing PCTSI tests on non-diesel-powered vehicles over 8,501 lbs. GVWR, most assumed the larger diesel vehicles would require the equivalent stationary diesel test. Unlike the ASM tests, which require authorization to switch a vehicle from ASM to PCTSI test, opacity tests require no such authorization. In 2014, Applus implemented a new quality assurance report to identify these vehicles and inspectors for corrective action.

Camera Audits

There are three cameras connected to the emissions analyzer. If anyone of them fail or become unplugged, the emissions analyzer will set a lockout to prevent the use of the workstation. In addition, the Applus VID will generate non-compliance report for any emissions test transmitted with a missing test and video file. However during the normal operations at the Test Centers, cameras may become misaligned or obstructed. Using the program dashboard, Applus performs camera audits of all three cameras, at each Test Center. Each camera is turned on to ensure it operates as it should, the viewing angle is verified with no obstructions and the test video is recording. If an issue is identified that requires an onsite visit at the Test Center, a service ticket is generated and dispatched to the Applus field service. In 2014, Applus performed 2,075 Test Center camera audits; eight service tickets were opened to address alignment/refocusing issues, and three service tickets were opened to improve video recording angle.

DMV Video Audits

At any given time, two DMV auditors are assigned to perform video audits and other functions. Video audits monitor inspections during station operating hours via digital web cameras. Video audits have the following features:

- Real time monitoring/control of vehicle inspections;
- Video auditors can selectively view inspections; and
- If violations are detected, DMV cites the CTI.

Fraudulent Test Rate

Based on an independent review of trigger data, less than 0.1% of the inspections were suspect. This indicates that inspection fraud is not a serious problem in Connecticut.

Conclusion: Evaluation of the data demonstrates that Connecticut vigorously enforces proper inspection procedures. Inspection fraud is not a problem in Connecticut's I/M program. Connecticut actively investigates possible cases of inspection fraud and initiates corrective action. Less than 0.1% of the tests in Connecticut are suspect.

5.0 Quality Assurance Audits

The DMV and their contractor, Applus, perform the quality assurance (QA) audits required by EPA. Following is an overview of Connecticut's audits, and other QA activities conducted by DMV.

Overt Audits

EPA requires that Overt Audits be performed twice per year per station. DMV meets these requirements through use of the Emission Test Monitoring Report (ETMR). DMV Motor Vehicle Agents perform Overt Audits, and during each audit, they complete an ETMR form, which is then turned into their supervisor for review. These reports are then kept on file for three years. Each ETMR represents one station's overt audit.

Connecticut prepares ETMRs more frequently than required by EPA. Each month, at least one ETMR is performed on each station. In addition, Applus also performs overt audits. Connecticut also checks more items than required by EPA. Connecticut is continuing to evaluate the auditing process to build upon the program's success.

Stations	2014
Total Overt Audits Performed	2,388
No. of Stations Audited	225
No. of Times Each Station Was Audited (range)	1 ¹⁴ -21
No. of Stations That Passing Audits for the Entire Year	143
Total Number of Audits for which One or More Issues Were Reported	152
No. of Stations That Had Issues	82
No. of Stations That Had 1-3 Issues	75
No. of Stations That Had 4-6 Issues	5
No. of Stations That Had 7-9 Issues	2

<u>Agents</u>	2014
No. of Agents That Performed Audits During the Course of the Year	10
No. of Agents That Are No Longer Performing Overt Audits	2
No. of Agents That Are Currently Assigned to Perform Audits	8
No. of Audits per Agent (range)	9-603
No. of Station Issues Reported per Agent (range)	1-82

¹⁴ Some stations only received one audit because they either left the program in the beginning of the year or entered the program toward the end of the year.

Equipment Audits

Connecticut meets EPA's requirements for equipment audits. EPA requires that equipment audits be performed twice per year per station. In Connecticut, DMV performs at least two equipment audits each year in stations performing tailpipe tests. In addition, Applus performs additional equipment audits. Connecticut checks more equipment items than required by EPA. While an audit may require a station to discontinue tailpipe testing, it can continue OBD testing. Therefore, no stations were totally shut down due to a failed gas equipment audit. Results are presented below. In 2011 before the new equipment was installed, 67% of the stations failed equipment (gas) audits, while in 2014 this percentage dropped to 29%. The drop was due to the roll out of new, more reliable emission test benches in the new program.

Results of Equipment Audits

Parameter	2014
Total Equipment Audits (Some stations either left the program in the beginning of the year or entered the program toward the end of the year.)	447
Total Stations that Failed Equipment Audit	130
Percentage of stations that failed an equipment (gas) audit	29.08%
Number of stations totally shut down as a result of a failed equipment (gas) audit ¹⁵	0
Percentage of stations shut down as a result of failed equipment (gas) audit	0.00%

The Connecticut Vehicle Inspection Program, by Federal guidance, does not have any emissions testing stations that perform enough emissions tests to be classified as high volume. Final Technical Guidance (EPA 420-B-04-011 July 2004) provides that high volume stations are those that perform 4,000 or more emissions tests per year. High volume stations are required to be audited monthly. Below is a list of 25 emissions testing stations with the largest volume of ASM Testing for testing year 2014. None perform close to 4,000 inspections per year.

¹⁵ Stations that fail equipment audit are prohibited from performing tailpipe emission testing until the equipment problem was resolved. Stations were allowed to continue to perform OBD testing.

ASM Test Volume by Station

Station ID	Total of all Test Types	Fail	Pass	# of ASM Tests
ST0003449	15,371	221	853	1074
ST0003192	15,501	173	696	869
ST0003432	14,184	178	598	776
ST0004867	10,751	159	487	646
ST0004257	9,885	128	510	638
ST0001193	9,473	128	493	621
ST0000725	9,113	125	467	592
ST0003548	10,093	110	463	573
ST0004107	14,830	108	436	544
ST0000581	10,865	79	460	539
ST0001876	9,475	56	437	493
ST0001805	7,724	99	388	487
ST0002880	7,244	72	404	476
ST0004722	14,677	80	391	471
ST0003498	8,352	75	372	447
ST0004854	10,573	73	371	444
ST0004788	6,580	103	338	441
ST0005016	7,840	63	375	438
ST0000386	11,060	63	368	431
ST0003107	6,536	69	349	418
ST0001401	5,349	91	320	411
ST0001297	5,953	74	335	409
ST0002964	8,834	73	336	409
ST0000776	7,728	56	341	397
ST0001216	9,196	64	327	391

Covert Audits

EPA requires that covert audits be performed at least once per year per station. DMV meets these requirements by performing covert audits and video surveillance audits. During 2014, DMV performed 775 covert audits and 1,529 video surveillance audits. Video audits repeatedly have been proven to be as or more effective than covert audits in detecting fraud. DMV performs video surveillance audits on a semi-random basis. After each station receives a video audit, DMV starts a new cycle of audits.

As noted above, DMV performed 775 covert vehicle audits in 2014. Most stations received at least two audits. To address EPA's comments on the 2012 Annual Report, vehicles requiring OBD, ASM and PCTSI tests are used for covert audits. Some of the vehicles are set to fail. Details are provided in Appendix B. Connecticut exceeds EPA's requirements for covert audits by a significant margin.

Warnings are routinely issued for false passes if DMV does not find that the CTI intentionally or negligently falsely passed a vehicle, thus there can be a difference between the number of false passes and suspensions. Suspensions are usually associated with violations found from trigger reports and data audits. Most false passes are for minor procedural errors, such as failing to perform the visual MIL check correctly. Unless the station repeats these errors, they are issued warnings rather than being suspended.

As stated in the Applus contract, and in the Applus Station Agreement, a CTI is suspended (pending an investigation) when it is determined that the false pass was the result of intentionally improperly passing a failing vehicle. Most errors identified by covert and video surveillance audits were determined to be unintentional and due to poor attention to detail. However, a second occurrence of making a careless error, such as missing or incorrectly answering the MIL question, results in an automatic suspension.

As noted above, the Connecticut I/M program is a model for running trigger reports and following-up on the issues identified as a result of these reports. Suspensions for violations other than covert audit findings or triggers were for various reasons as outlined in the contract under "Inspector Violations," including, but not limited to data entry errors or incorrect test procedures. The statutory and regulatory authority for the I/M program does not allow Connecticut to issue fines or hold hearings concerning inspectors that falsely pass vehicles in covert audits. Instead, these inspectors are suspended from testing. Whether or not to suspend a station depends on the assessment of the severity of the infraction by Applus.

Contractor Quality Assurance (QA) Activities

The contractor, Applus, performs comprehensive overt and equipment audits biennially, at each facility that participates in the inspection program. These unannounced audits include:

- The visual inspection and physical condition of the testing equipment;
- Equipment integrity checks using traceable/certified audit equipment; and
- Observation of the proficiency of at least one inspector.

The contractor's auditor evaluates the physical condition, functionality, and inventory of all the required emissions components and any ancillary safety items (restraining straps, wheel chocks, dynamometer tie down hooks, etc.). The emissions analyzer must pass calibrations (leak check, gas bench, dynamometer, gas cap, OBD, and opacity, if equipped).

In addition, there are several system components that are audited using National Institute of Standards and Technology (NIST) certified and traceable audit equipment:

- Gas Bench(s) Audit – NIST traceable audit gas
- Weather Station Audit - Certified temperature/humidity/pressure probes
- Opacity Audit - Reference filters (20%, 35%, 50%, and 75%)
- OBD System Audit – EASE OBDII Verification Tester

In accordance with the Quality Assurance and Quality Control Plan, the contractor's auditor uses a pre-printed checklist to inventory and record the physical condition of the test equipment. All non-conforming items are addressed immediately; the auditor's van is equipped to replace missing station inventory at the time of the audit. If an issue is identified that cannot be addressed by the auditor, he or she will create a service ticket for Applus field service.

In 2014, the contractor's auditor performed 442 audits; 329 audits passed, and 113 failed. Most common failures included gas bench calibration or gas bench audit.

Built-in Anti-Fraud Prevention Systems

In addition to Connecticut's efforts to eliminate fraudulent and inaccurate tests, the State's contractor, Applus, has implemented systems to prevent fraud, including the Connecticut Decentralized Analyzer System (CDAS), provided by Applus, which has features to assure that accurate emissions tests are performed. These systems and features are listed below:

- Secure iris recognition system – use of biometrics
- Sample system leak check
- Analyzer gas calibrations – Every 72 hours or system will lock out testing

- CDAS units require a two point calibration with BAR 97 high gas followed by BAR 97 low gas blend
- CDAS units have passed BAR 97 certification tests
- Dynamometer undergo a coast down every 72 hours
- Raw transport time verification
- Various other hardware checks are done every 72 hours
- Low sample flow, sample dilution checks etc.

Conclusion: Connecticut exceeds EPA's recommended levels of quality assurance. High quality, fraud-free inspections are the norm in Connecticut.

6.0 Assessment of OBD Testing Issues

Vehicles with Readiness Issues that are Not Currently Exempted from Readiness Requirements

EPA allows states to exempt vehicles from readiness requirements if they have design flaws that cause them to frequently fail for readiness. In 2007, Connecticut updated its readiness exemption list to include vehicles that had extremely high not ready rates. Based on data from tests performed in 2014, no additional vehicle models need to be added to the readiness exemption list. ***Connecticut does not need to update its readiness exemption list at this time.***

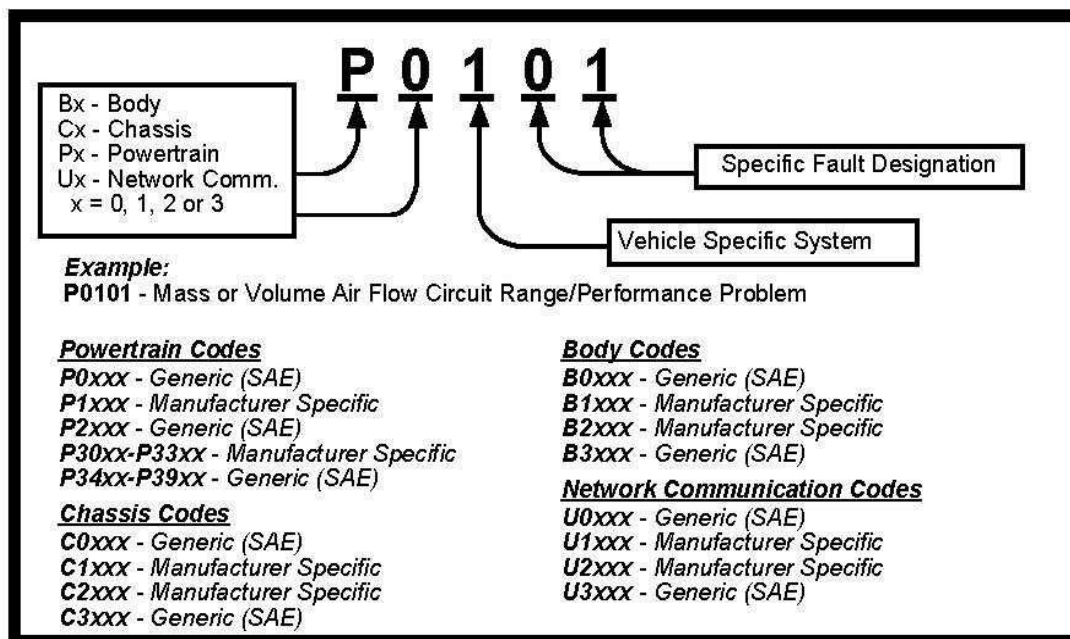
Vehicles That Fail to Communicate with Connecticut's Test System

A small percentage (0.2%) of the vehicles with OBDII systems fail to communicate with Connecticut's inspection system. This is much lower than the no-communication rate observed with the old testing equipment in 2011 and earlier years, indicating that the new OBD inspection equipment works well. For this report, Connecticut analyzed 2014 inspection data to determine no communication rates by year, make, and model. Specific year/make/models that had high no-communication rates are shown below. Applus continues to investigate why CDAS have difficulty communicating with these vehicles. As mentioned in the next section, Applus will be implementing a new OBDII interface termed DAD (Data Acquisition Device).

Specific Vehicles with High No Communication Rates			
Year Make Model	# Fail COM	% Fail COM	Count
2006_Mercedes-Benz_C-Class	107	29.40%	364
1996_Hyundai_Accent	4	20.00%	20
2009_Mitsubishi_Eclipse	3	12.00%	25
2003_Mazda_MAZDA6	23	11.33%	203
1999_Audi_A8	2	10.00%	20
1999_Mazda_626	14	9.59%	146
2004_Mazda_MAZDA6	55	9.34%	589
2001_Mazda_MPV	7	8.97%	78
2010_BMW_1 Series	3	8.57%	35
2002_Mazda_MPV	8	7.21%	111
1996_Ford_Thunderbird	2	6.90%	29
2000_Audi_A6	12	6.22%	193
1997_Hyundai_Elantra	2	6.06%	33

Diagnostic Trouble Codes (DTCs) Recorded in OBDII Failures

The Malfunction Indicator Light (MIL) is part of the OBD system and is used to alert the driver of a potential issue with the vehicle's computerized engine management system. Whenever the MIL is illuminated a Diagnostic Trouble Code (DTC) should be stored in the vehicle's computer. DTCs describe the problem that caused illumination of the MIL. Before OBDII, each manufacturer had their own specific trouble code list and code definitions. Under the OBDII requirements, all manufacturers must comply with a standardized convention for DTCs. The universal DTC format consists of a 5-character alphanumeric code, consisting of a single letter character followed by four numbers. The following is an example of the standardized coding for DTCs.



Top 10 DTCs in Connecticut

Following is a list of the most prevalent DTCs in Connecticut in 2014. This table lists the ranking of the most prevalent DTCs along with the frequency of its occurrence, expressed as a percentage of MIL-On cases. Note that the top 10 DTCs are present in about 61% of the MIL-on cases in 2014, even though there are over 1000 possible DTCs.

Connecticut's Top 10 DTCs -- 2014

DTC	Rank	%
P0420 -- Low Catalyst Efficiency	1	13.61%
P0171 -- System Too Lean: Bank 1	2	7.92%
P0442 -- Evaporative Emission Control System Leak Detected (small leak)	3	7.43%
P0455 -- Evaporative Emission Control System Leak Detected (gross leak)	4	7.09%
P0300 -- Random Misfire	5	5.79%
P0174 -- System Too Lean: Bank 2	6	4.46%
P0141 -- O2 Sensor Heater Circuit Malfunction	7	3.85%
P0440 -- Evaporative Emission Control System Malfunction	8	3.85%
P0135 -- O2 Sensor Heater Circuit Malfunction	9	3.71%
P0128 -- Coolant Thermostat (Coolant Temperature Below Thermostat Regulating Temperature)	10	3.62%
Total of the top 10		61.33%

7.0 Program Enhancements in 2014 and in the Future

DEEP and DMV evaluate Connecticut's I/M program to ensure that it continues to operate accurately and effectively while assuring air quality benefits are achieved. In 2011, DMV executed a new contract to upgrade the I/M program. The new program continues to perform tailpipe tests on pre-1996 vehicles, which do not have OBD systems. This will maintain the air quality benefits necessary to meet Clean Air Act requirements and statutory restrictions.

The new program upgraded the inspection equipment. A new type of bench, which is known to be more reliable, was utilized, resolving the high rate of equipment (gas) auditing failures. The OBDII interface has much lower no-communication rates than the old interface. Another significant improvement is that the vendor now supplies the vehicles for covert auditing, while DMV staff continues to conduct the audits. Connecticut will continue with stringent quality assurance and fraud detection activities.

In 2014, additional enhancements were made in the following areas:

1. Cleaned-up the Certified Inspector (CTI) records in the Electronic Data-Base Management System (EDBMS): For various reasons, over the years, there were inspectors that should have been deactivated, locked-out, and unassigned from stations but instead remained in the EDBMS. To ensure that only currently certified CTIs test, the list of active CTIs in the EDBMS was reviewed and updated in 2014, which resulted in a reduction from previous years. Furthermore, DMV took the following additional steps to ensure that the list remains as up to date as possible:
 - a. All test stations were contacted, and asked to verify their currently employed CTIs, and the EDBMS was updated, accordingly.
 - b. Based upon this change in policy, a monthly query is now run that identifies CTIs that have not performed tests in the last six months, or more. Once these individuals are identified, the CTI gets locked out, deactivated, and unassigned. At this juncture, the CTI would be required to attend a full eight hour training session, in order to resume testing.
 - c. Stations are now required to provide a staffing plan before any new training applications are processed. Any assigned inspectors not on the staffing plan will be locked out, deactivated, and unassigned.
2. Diversity Language Changes: DMV expanded efforts to inform stakeholders of its zero tolerance policy for any type of discrimination or inappropriate comments.
 - a. The DMV added a diversity section to the CTI and recertification training classes. This issue was merged into the state portion of the class, and is taught by DMV personnel. This new section explains zero tolerance, within any aspect of the emissions program, for any type of

discrimination, including but not limited to race, gender, creed, color, sexual orientation, or any other type of discrimination.

3. New Emissions Database Management System (EDBMS): The old EDBMS was old and had frequent outages. The EDBMS has been in service since 2003. In 2014, there were multiple outages, mostly for unknown and unexplained reasons. Often, when the server was slow, or not responding, the resolution was to shut it down and restart it. During 2014, DMV worked with a consultant to develop specifications for the new EDBMS:
 - a. DMV began developing the new EDBMS with the new EDBMS vendor (Applus) and began preparing to transition from the old vendor.
 - b. DMV initiated the integration of the Connecticut Integrated Vehicle and Licensing System (CIVLS), which is the new upgraded computer system that will be used by DMV for licensing and registration, into the EDBMS
4. Improved Auditing Procedures:
 - a. The calibration gas manufacturer now guarantees that the gas cylinders have been recently filled. This eliminates the problem of DMV purchasing expired or close to expired gases.
 - b. In 2014, DMV revised the Emission Test Monitoring Report (ETMR). The revised ETMR now requires a station manager's signature, requires the agent to record the expiration dates of all calibration gas cylinders that are in use, and instructs the agent to observe only one emissions test, if available, before proceeding to the next station.
5. Analyzer Upgrades: The following analyzer upgrades were made in 2014:
 - a. To ensure that an accurate engine temperature is recorded during inspections, a software change was implemented in the Connecticut Decentralized Analyzer System (CDAS). This change prevents ASM, TSI, and opacity tests from going forward if the recorded engine temperature exceeds 250°F.
 - b. During PCTSI and opacity tests, Applus added a screen prompt for the CTI to use the cooling fan when the ambient temperature exceed 70 degrees. Previously, this prompt only appeared during ASM tests.
 - c. Preventative maintenance on CDAS was enhanced:
 - i. DMV now frequently accesses the enhanced comprehensive Work Order database. This practice enhances DMV oversight of program repair and maintenance. A review of the work order database in 2014 brought about a service campaign of the roller stop brake pads for all of the Mustang Dynamometers used in the program.
 - ii. DMV now directly communicates with the manufacturers of equipment used in the program to ensure product reliability and conformance to the manufacturers' maintenance requirements and

repair procedures.

- iii. In 2014, DMV introduced an improved OBDII testing cable. This provided an increase in the reliability in the CT VIP.
- d. DMV initiated the process to incorporate the California Data Acquisition Device (DAD) into CDAS units.
 - i. This device will improve analyzer to vehicle communication and will allow for the analyzer to perform a calibration before each OBD test. The device is already installed in all CDAS units, testing the software is complete, and DMV anticipates the DAD will be in use before the fall of 2015.
 - ii. There are several major benefits of switching to the DAD, including improved internal and external self-checks. The self-check performed by the analyzer will be able to quickly identify a bad OBD cable. In addition to the improved cable integrity, the DAD will offer faster interrogation with vehicle OBD systems resulting in quicker tests and offers more accurate collection of Mode/PID data and various combinations. The firmware in the DAD will also be upgradable; therefore if a problematic vehicle is identified, updates can occur without doing a full analyzer software change and Acceptance Test Plan.
 - iii. Software was designed to work with both the current Multiplex and future DAD modules. In anticipation of releasing the software, the DAD hardware components have been installed on all the analyzers.
 - iv. Chevrolet Volts are being successfully tested by Applus equipment in California using the DAD device. The developers at Applus are confident that the DAD device will communicate with Chevrolet Volts here as well, to resolve the plug in hybrid electric vehicle testing issue.
- 6. Changes to waiver procedure: Now motorists must send in their repair data forms before an agent meets them out in the field. The prior procedure was to verify over the phone that the paperwork such as failed emissions tests, repair receipts for qualifying repairs, and a repair data form signed by the certified repairer meets all waiver requirements. Then, a Motor Vehicle Agent would meet the customer, verify paperwork, inspect the vehicle, and issue or deny the waiver. Sometimes the motorist would not bring all, or in some cases, any paperwork, therefore, the system was put in place for the vehicle owner to submit all paperwork prior to the inspection. Once office personnel verify that all documentation indicates that the vehicle may qualify for a waiver, an appointment is made and the physical inspection of the vehicle is done. This eliminates cases where field staff meets motorists only to find out that not all required items were brought for inspection. Additionally, motorists still have the option to visit the DMV headquarters, in Wethersfield, to apply for a waiver in

person. At the DMV headquarters, customers have the option to make an appointment, or walk in, to receive the paperwork review and vehicle inspection all in one visit.

7. CTI Recertification: CTI recertification is now automated, and the CTI can now take the recertification pre-entrance exam on any PC including the emissions analyzer itself. The revamped exam includes updated questions, including a question about diversity.
8. Reducing Failure Rates: There are many efforts underway to decrease failure rates in CT and they are as follows:
 - a. Incorporating DAD as discussed above will reduce failures due to no communication between CDAS and the vehicle's OBD system.
 - b. New Temperature Gun: An emissions test cannot continue if the recorded engine temperature exceeds 250°F. Prior to the change, some engine temperature readings exceeded 250°F with some as high as the maximum of 999°F. Most of the excessive readings were due to the location where the CTI was aiming the IR temp gun. However, some of the 999°F readings were also due to errors resulting from a low battery in the temperature gun.
 - c. Repair Effectiveness Index (REI) – Currently under development. DMV received a demonstration of some of the features of the new REI that is under development. The REI will help motorists get their vehicles repaired at stations that have proven track records.
 - d. Automotive Service Excellence (ASE) certification and manufacturer trained technicians will be able to become Certified Emissions Repair Technicians (CERTS). Repairs by ASE certified repair and certain manufacturer trained technicians will be accepted as qualifying repairs towards cost waiver qualifications. This change should improve repair quality and reduce failure rates during the next inspection cycle.

Connecticut will continue to seek out additional opportunities to increase the effectiveness of the program.

8.0 Conclusions

Key conclusions from this analysis:

- ❖ Connecticut's I/M program is achieving air quality benefits. Key indicators include a high compliance rate (99%), limited fraud, low waiver rate and an overall failure rate of 10% in 2014, which demonstrates that Connecticut is failing the expected number of vehicles, a key metric of program success.
- ❖ Connecticut actively investigates non-compliance and assesses fines for late inspections. In 2014, 162,311 fines were assessed for late inspections. Linking registration to compliance in addition to assessing late inspection fines contribute to Connecticut's very high compliance rate. The enforcement of Connecticut's I/M program exceeds the enforcement levels assumed in emissions modeling for the Connecticut SIP.
- ❖ Connecticut conducts extensive compliance assurance activities on the I/M program. Evaluation of these quality assurance data demonstrates that the program performs accurate inspections. Connecticut is a national model for other states' enforcement activities.
- ❖ Connecticut's new I/M contract is designed to ensure the I/M program continues to effectively achieve the expected air quality benefits. Of note, the program has successfully addressed key equipment challenges, including requiring more reliable emission test benches and better communication between vehicles and the OBD inspection equipment. DMV will continue to resolve challenges as they arise, such as testing for plug in hybrid electric vehicles and fleet vehicles.

Appendix A

EPA Checklist

Appendix A:
40 CFR Part 51 - Subpart S Inspection/Maintenance Program Requirements
51.366 - Data Analysis and Reporting Requirements

<u>Reporting Requirement</u>	<u>Reviewer Comments / Location in State Report</u>	<u>Has the State Met the Requirement?</u>
<p>(a) <u>Test Data Report</u></p> <p>The program shall submit to EPA by July of each year a report providing basic statistics on the testing program for January through December of the previous year, including:</p>		
(1) The number of vehicles tested by model year and vehicle type;		
(2) By model year and vehicle type, the number and percentage of vehicles:		
(i) Failing initially, per test type;		
(ii) Failing the first retest per test type;		
(iii) Passing the first retest per test type;		

<u>Reporting Requirement</u>	<u>Reviewer Comments / Location in State Report</u>	<u>Has the State Met the Requirement?</u>
(iv) Initially failed vehicles passing the second or subsequent retest per test type;		
(v) Initially failed vehicles receiving a waiver; and		
(vi) Vehicles with no known final outcome (regardless of reason). (vii)-(x) [Reserved]		
(xi) Passing the on-board diagnostic check;		
(xii) Failing the on-board diagnostic check;		
(xiii) Failing the on-board diagnostic check and passing the tailpipe test (if applicable);		
(xiv) Failing the on-board diagnostic check and failing the tailpipe test (if applicable);		
(xv) Passing the on-board diagnostic check and failing the I/M gas cap evaporative system test (if applicable);		
(xvi) Failing the on-board diagnostic check and passing the I/M gas cap evaporative system test (if applicable);		

<u>Reporting Requirement</u>	<u>Reviewer Comments / Location in State Report</u>	<u>Has the State Met the Requirement?</u>
(xvii) Passing both the on-board diagnostic check and I/M gas cap evaporative system test (if applicable);		
(xviii) Failing both the on-board diagnostic check and I/M gas cap evaporative system test (if applicable);		
(xix) MIL is commanded on and no codes are stored;		
(xx) MIL is not commanded on and codes are stored;		
(xxi) MIL is commanded on and codes are stored;		
(xxii) MIL is not commanded on and codes are not stored;		
(xxiii) Readiness status indicates that the evaluation is not complete for any module supported by on-board diagnostic systems;		
(3) The initial test volume by model year and test station;		
(4) The initial test failure rate by model year and test station; and		

<u>Reporting Requirement</u>	<u>Reviewer Comments / Location in State Report</u>	<u>Has the State Met the Requirement?</u>
(5) The average increase or decrease in tailpipe emission levels for HC, CO, and NOX (if applicable) after repairs by model year and vehicle type for vehicles receiving a mass emissions test.		
<p>(b) <u>Quality assurance report.</u></p> <p>The program shall submit to EPA by July of each year a report providing basic statistics on the quality assurance program for January through December of the previous year, including:</p>		
(1) The number of inspection stations and lanes:		
(i) Operating throughout the year; and		
(2) The number of inspection stations and lanes operating throughout the year:		
(i) Receiving overt performance audits in the year;		
(ii) Not receiving overt performance audits in the year;		
(iii) Receiving covert performance audits in the year;		

<u>Reporting Requirement</u>	<u>Reviewer Comments / Location in State Report</u>	<u>Has the State Met the Requirement?</u>
(iv) Not receiving covert performance audits in the year; and		
(v) That have been shut down as a result of overt performance audits;		
(3) The number of covert audits:		
(i) Conducted with the vehicle set to fail per test type;		
(ii) Conducted with the vehicle set to fail any combination of two or more test types;		
(iii) Resulting in a false pass per test type;		
(iv) Resulting in a false pass for any combination of two or more test types;		
(4) The number of inspectors and stations:		
(i) That were suspended, fired, or otherwise prohibited from testing as a result of covert audits;		
(ii) That were suspended, fired, or otherwise prohibited from testing for other causes; and		

<u>Reporting Requirement</u>	<u>Reviewer Comments / Location in State Report</u>	<u>Has the State Met the Requirement?</u>
(iii) That received fines;		
(5) The number of inspectors licensed or certified to conduct testing;		
(6) The number of hearings:		
(i) Held to consider adverse actions against inspectors and stations; and		
(ii) Resulting in adverse actions against inspectors and stations;		
(7) The total amount collected in fines from inspectors and stations by type of violation;		
(8) The total number of covert vehicles available for undercover audits over the year; and		
(9) The number of covert auditors available for undercover audits.		

<u>Reporting Requirement</u>	<u>Reviewer Comments / Location in State Report</u>	<u>Has the State Met the Requirement?</u>
<u>(c) Quality control report</u> The program shall submit to EPA by July of each year a report providing basic statistics on the quality control program for January through December of the previous year, including:		
(1) The number of emission testing sites and lanes in use in the program;		
(2) The number of equipment audits by station and lane;		
(3) The number and percentage of stations that have failed equipment audits; and		
(4) Number and percentage of stations and lanes shut down as a result of equipment audits.		

<u>Reporting Requirement</u>	<u>Reviewer Comments / Location in State Report</u>	<u>Has the State Met the Requirement?</u>
<p>(d) <u>Enforcement report.</u></p> <p>(1) All varieties of enforcement programs shall, at a minimum, submit to EPA by July of each year a report providing basic statistics on the enforcement program for January through December of the previous year, including:</p>		
(i) An estimate of the number of vehicles subject to the inspection program, including the results of an analysis of the registration data base;		
(ii) The percentage of motorist compliance based upon a comparison of the number of valid final tests with the number of subject vehicles;		
(iii) The total number of compliance documents issued to inspection stations;		
(iv) The number of missing compliance documents;		
(v) The number of time extensions and other exemptions granted to motorists; and		

<u>Reporting Requirement</u>	<u>Reviewer Comments / Location in State Report</u>	<u>Has the State Met the Requirement?</u>
(vi) The number of compliance surveys conducted, number of vehicles surveyed in each, and the compliance rates found.		
(2) Registration denial based enforcement programs shall provide the following additional information:		
(i) A report of the program's efforts and actions to prevent motorists from falsely registering vehicles out of the program area or falsely changing fuel type or weight class on the vehicle registration, and the results of special studies to investigate the frequency of such activity; and		
(ii) The number of registration file audits, number of registrations reviewed, and compliance rates found in such audits.		
(3) Computer-matching based enforcement programs shall provide the following additional information:		
(i) The number and percentage of subject vehicles that were tested by the initial deadline, and by other milestones in the cycle;		

<u>Reporting Requirement</u>	<u>Reviewer Comments / Location in State Report</u>	<u>Has the State Met the Requirement?</u>
(ii) A report on the program's efforts to detect and enforce against motorists falsely changing vehicle classifications to circumvent program requirements, and the frequency of this type of activity; and		
(iii) The number of enforcement system audits, and the error rate found during those audits.		
(4) Sticker-based enforcement systems shall provide the following additional information:		
(i) A report on the program's efforts to prevent, detect, and enforce against sticker theft and counterfeiting, and the frequency of this type of activity;		
(ii) A report on the program's efforts to detect and enforce against motorists falsely changing vehicle classifications to circumvent program requirements, and the frequency of this type of activity; and		
(iii) The number of parking lot sticker audits conducted, the number of vehicles surveyed in each, and the noncompliance rate found during those audits.		

<u>Reporting Requirement</u>	<u>Reviewer Comments / Location in State Report</u>	<u>Has the State Met the Requirement?</u>
<p>(e) <u>Additional reporting requirements.</u></p> <p>In addition to the annual reports in paragraphs (a) through (d) of this section, programs shall submit to EPA by July of every other year, biennial reports addressing:</p>		
<p>(1) Any changes made in program design, funding, personnel levels, procedures, regulations, and legal authority, with detailed discussion and evaluation of the impact on the program of all such changes; and</p>		
<p>(2) Any weaknesses or problems identified in the program within the two-year reporting period, what steps have already been taken to correct those problems, the results of those steps, and any future efforts planned.</p>		

Appendix B

2014 CT I/M Program Data

In separate document